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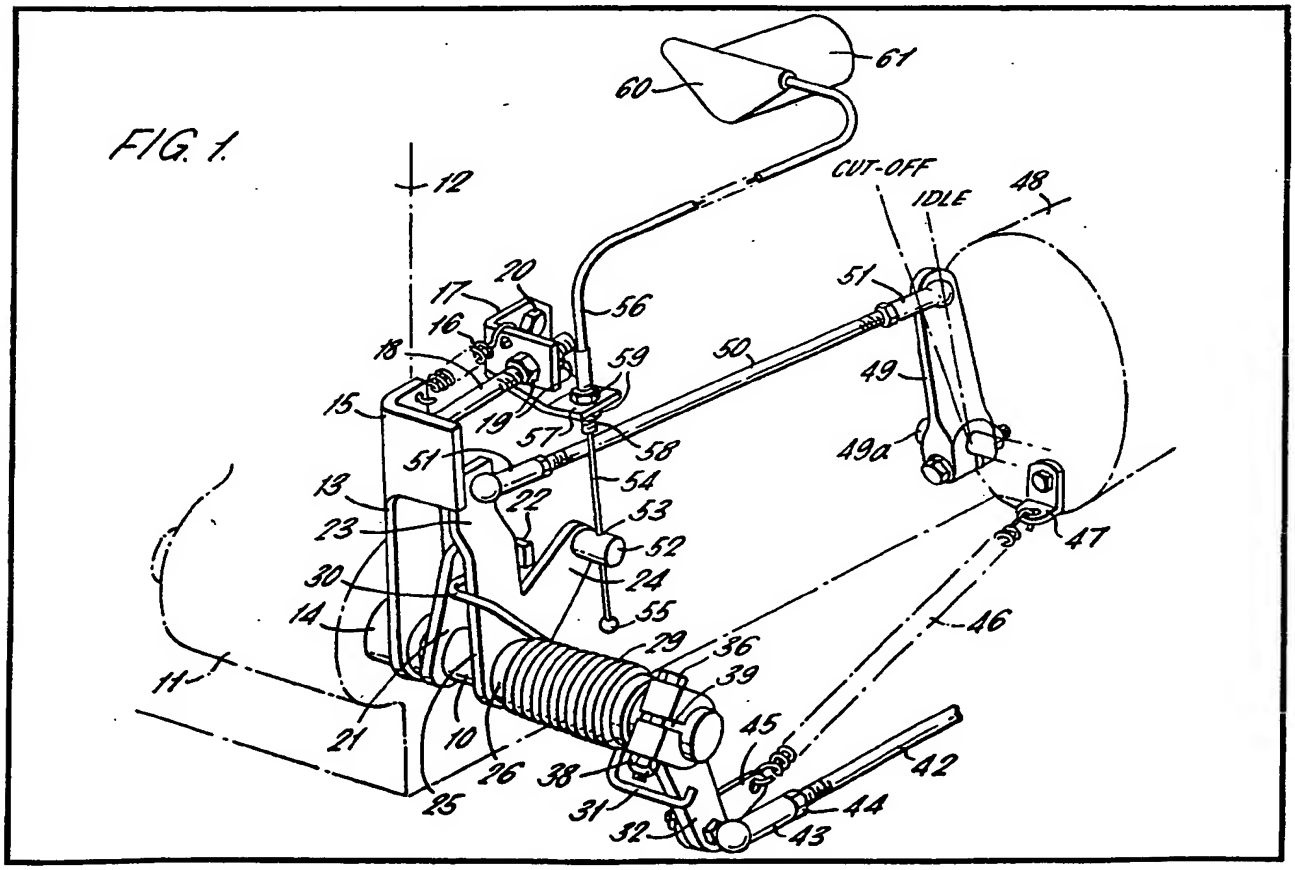
(54) Fuel pump control mechanism

(57) A fuel pump (48) for a diesel engine has a control lever (49) movable from "cut-off", through "idle", to "maximum". An accelerator mechanism has a first part (42,22) movable with an accelerator pedal between "idle" and "maximum", and a second part (23,24,50) movable with the control lever (49) and urged by a spring (29) to follow the first part from "idle" to "maximum". A further mechanism has a "cut-off" position in which it holds the second part (24) in the "cut-off" position irrespective of movement of the accelerator, and a "running" position in which it permits the second part to follow the movement of the accelerator. To provide such action, the further mechanism comprises a bowden cable mechanism, a boss (52) on the second part sliding along an end portion (54) of the inner cable when in the "running" position and being held by a nipple (55) on the end of the inner cable when in the "cut-off" position. The inner cable is operated by a reversible electric motor (61) connected to a switch (62), Fig. 5 (not shown), associated with a vehicle steering column lock. An idling stop (18) is abutted by a lever (13), engaged by the lever (23), in the idling position of the accelerator pedal.



The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

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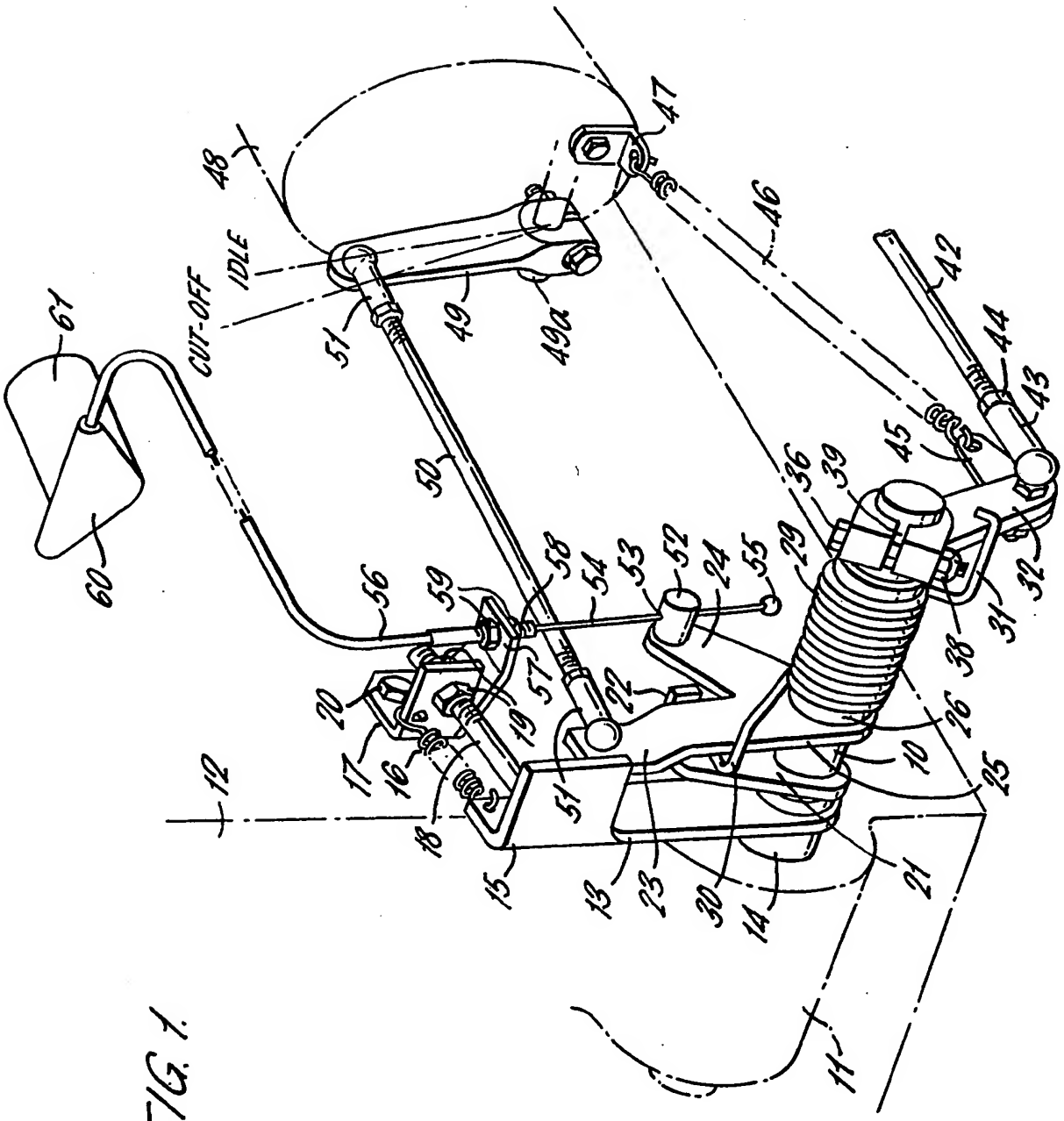


FIG. 1.

FIG. 2.

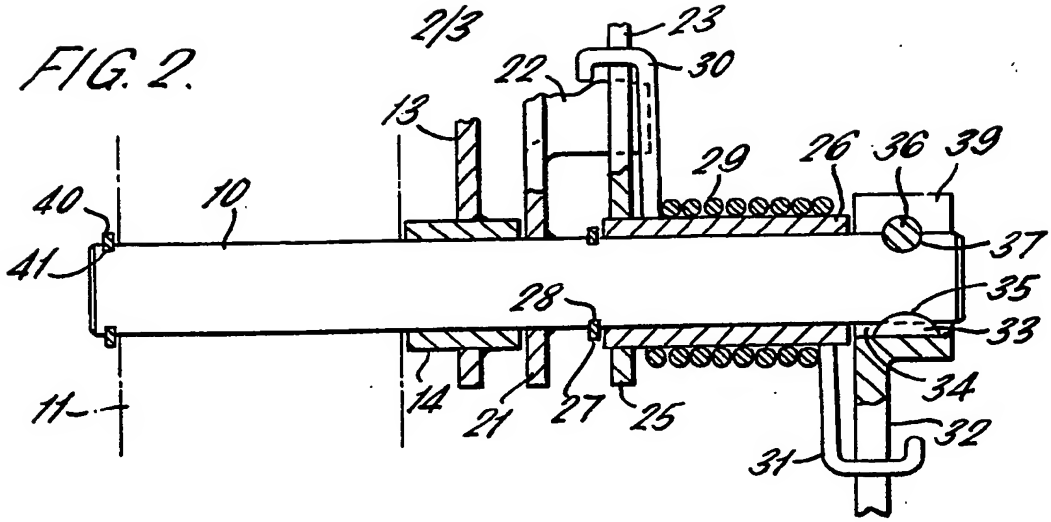


FIG. 4.

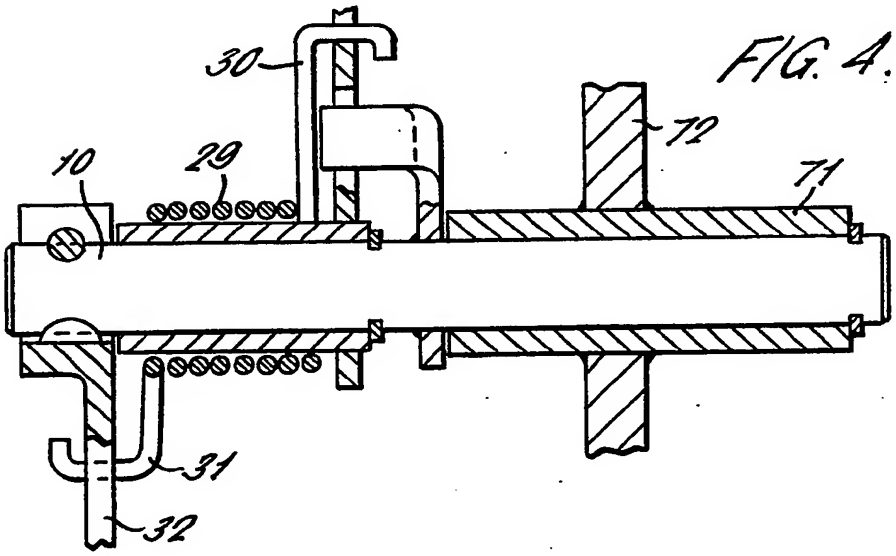


FIG. 5.

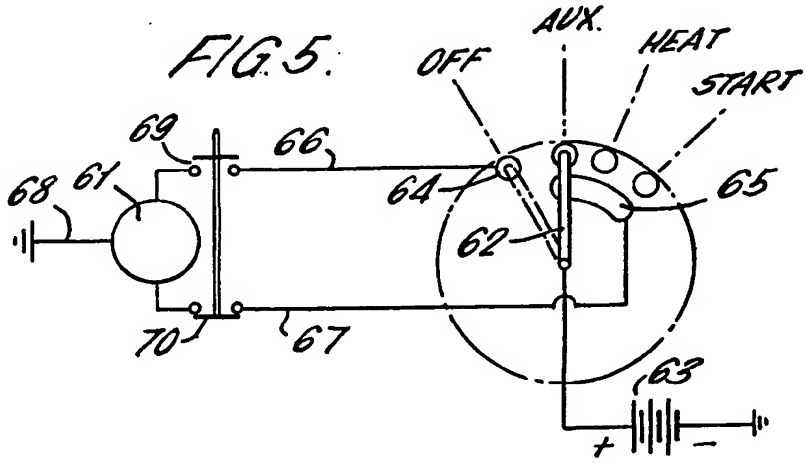
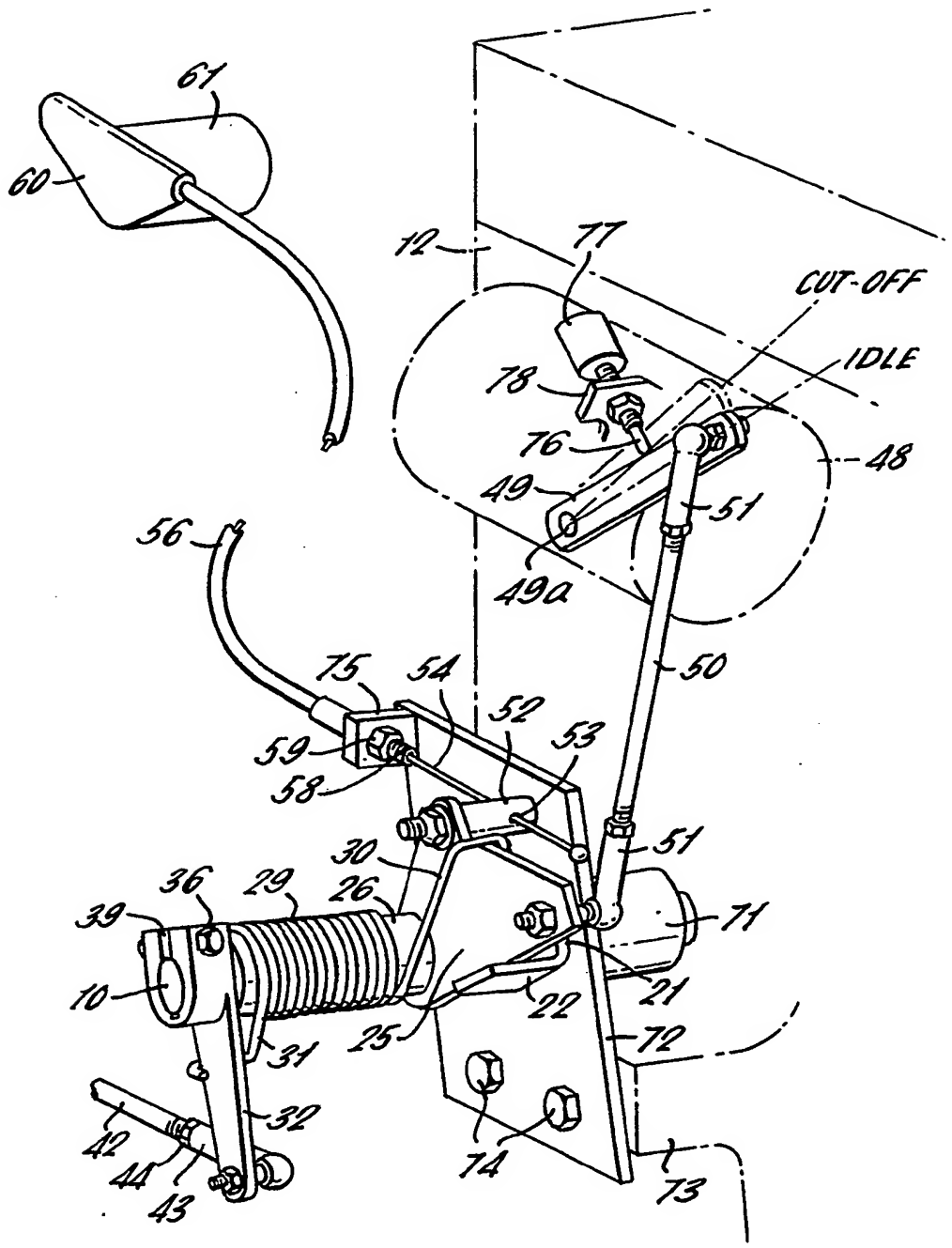


FIG. 3.



SPECIFICATION

Fu l pumps having contr l mechanisms

This invention relates to fuel pumps having control mechanisms.

According to one aspect of the present invention there is provided a fuel pump having a control mechanism including a pump control movable from a cut-off position through an idle position to a maximum position, an accelerator mechanism for moving the pump control between the idle and maximum positions and a further mechanism for moving the pump control to and holding the control in the cut-off position irrespective of operation of the accelerator mechanism.

Preferably, the accelerator mechanism comprises a first part movable with an accelerator for the fuel pump and a second part movable with the pump control, spring means being provided between said parts and the arrangement being such that the spring means urges the second part into direct engagement with the first part to follow the first part during movement of the accelerator in a direction to move the pump control towards the maximum position, the further mechanism acting on the second part for moving the second part to and holding the second part in a position corresponding to the cut-off position of the pump control, in which position movement of the accelerator causes relative movement between the two parts against the action of the spring means.

The further mechanism preferably comprises an element having a lost-motion connection to the second part and being movable between a running position and a cut-off position, so that in the running position of the element the lost-motion connection permits movement of the second part relative to the element between positions corresponding to the idle and maximum positions of the pump control, and so that in the cut-off position of the element the lost motion is taken up and the second part is held in the position corresponding to the cut-off position of the pump control.

Said element may be the inner cable of a bowden cable mechanism and the second part may be provided with a boss having a hole passing therethrough, an end portion of the inner cable passing freely through the hole and a nipple being secured to that end of the inner cable, so that in the running position of the inner cable the lost motion is provided by movement of the boss along the end portion of the inner cable, and so that in the cut-off position of the inner cable the nipple abuts the boss and holds the second part in the position corresponding to the cut-off position of the pump control.

A reversible electric motor may be connected to the other end of the bowden cable mechanism to drive the inner cable between the running and cut-off positions.

Preferably the motor is connected in circuit with a switch and a power source, the circuit being arranged so that for at least one position of the switch the motor drives the inner cable to the running position and so that for at least one other position of the switch the motor drives the inner cable to the cut-off position.

The motor is preferably of the double wound type, the windings each having one end connected to the power source, the other end of one of the windings being connected to the switch for energisation when the switch is in said one position to rotate the motor in one direction to drive the inner cable to the running position and the other end of the other winding being connected to the switch for energisation when the switch is in said other position to rotate the motor in the opposite direction to drive the inner cable to the cut-off position.

Said one winding may be connected in series with a limit switch responsive to position of the inner cable to de-energise that winding when the inner cable is in the running position and said other winding may be connected in series with a further limit switch responsive to position of the inner cable to de-energise that winding when the inner cable is in the cut-off position.

Preferably, the first part comprises a shaft having a first crank fixed thereto and linked to the accelerator and having a second crank fixed thereto, and the second part comprises a further crank mounted on the shaft for pivotal movement about the axis thereof and linked to the pump control, the spring means acting between the first crank and the further crank and the arrangement being such that the spring means urges the further crank into direct engagement with the second crank to follow the second crank during movement of the accelerator in the direction to move the pump towards the maximum position.

An adjustable stop may be provided for setting the idle position of the pump control, the stop being spring loaded to permit movement of the pump control to the cut-off position.

According to a further aspect of the invention there is provided a motor vehicle having a fuel pump as defined above, wherein the further mechanism is operable by a driver of the vehicle from the driving position.

According to another aspect of the invention there is provided a motor vehicle having a fuel pump as defined above of the type having a motor and switch, wherein the switch is controlled by a key operated mechanism which also controls a steering lock and a starter motor of the vehicle.

Two embodiments of the invention will now be described by way of example, reference

being made to the accompanying drawings, in which:

Figure 1 is a part-diagrammatic perspective view of one embodiment of the invention;

Figure 2 is a sectional view of part of the embodiment of Fig. 1 with certain elements shown out of position for clarity;

Figure 3 is a part-diagrammatic perspective view of a further embodiment of the invention;

Figure 4 is a similar sectional view to Fig. 2 of part of the embodiment of Fig. 3; and

Figure 5 is an electrical circuit diagram suitable for the embodiments shown in Figs. 1 and 3.

Referring to Figs. 1 and 2, a fuel supply and shut-off mechanism for a diesel engine comprises a shaft 10 journalled for rotation in a housing 11 formed in an engine cylinder block 12 at the rear and to one side thereof such that the shaft extends axially horizontally outwards of the right hand side of the cylinder block transversely of the longitudinal axis of the engine.

One end of a stop lever 13 has a cylindrical boss 14 with a through bore, the boss extending from both faces of the lever arm. The end of the lever remote from the boss is formed with a rectangular ear 15 extending transversely from one edge of the arm and parallel to the axis of the boss 14. The lever 13 is mounted for rotation on the shaft 10 with one end of the boss 14 contiguous with the outer end face of the housing 11 and ear 15 extending in a direction outwardly therefrom and parallel to the axis of shaft 10.

A tension spring 16 connected between one end of lever 13 and a bracket 17 holds the ear 15 of lever 13 against the end of a stop rod 18 the other end of which is screw-threaded and passes through a hole in bracket 17 to which it is axially adjustably secured by a nut 19 on either side of the bracket wall through which the rod passes. The bracket 17 being secured to the side of the engine block by set screw 20.

Lever 21 is located on the shaft 10 contiguous with the other end of boss 14 of lever 13 and is secured to the shaft e.g. by welding. The end of the lever arm remote from the shaft is formed with a rectangular ear 22 extending from the rear edge of the lever, parallel to the axis of shaft 10 on the opposite side to ear 15 and in the same direction thereof.

Two arms 23 and 24 are formed on a ball-crank lever 25 secured, e.g. by welding, to one end of an elongate cylindrical boss 26 having a through bore and mounted for rotation on shaft 10 such the boss extends outwardly of the lever which in turn is axially spaced outwardly of l ver 21 by a circlip 27 located in a circumferential groove 28 in shaft 10 such that the front and rear edges of arm 23 abut the adjacent faces of ears 22 and 15 respectively, the end of arm 23 being offset to facilitate such abutment.

A relatively strong torsional coil spring 29 having outwardly extending hooked arms 30, 31 at respective ends thereof co-axially encircles boss 26 with hooked arm 30 of the spring engaging over the rear edge of arm 23 and the hooked end 31 engaging over the rear edge of lever 32 mounted on the outer end of shaft and held fast for rotation therewith such that the forward edge of arm 23 is held in abutment with ear 22 on lever 21 by the predetermined fitted load of spring 29. Lever 32 is held fast for rotation with shaft 10 by key 33 located in corresponding slots 34, 35 in the boss of lever 32 and shaft 10 respectively together with pinch bolt 36 passing through holes in one side of the boss and a groove 37 in shaft 10 and retained therein by tightening nuts 38 on bolt 36, the boss of lever 32 being slotted at 39 radially from the bore diametrically opposite key slot 34 and parallel to the axis of the bore for this purpose. Axial movement of the shaft 10 relative to the housing 11 is prevented in the one direction by a circlip 40 engaged in a circumferential groove 41 in the end of the shaft 10 remote from lever 32 and in the other direction by lever 21 secured to the shaft 10.

One end of a link rod 42 is connected to lever 32 for universal movement relative thereto by means of a ball joint assembly 43 adjustably engaged over a screw-threaded end of rod 42 and retained against rotation thereon by a locknut 44. A mounting plate 45 has one end pivotably connected to lever 32 on the side of the lever opposite the ball joint as shown in Fig. 1 and a coiled tension spring 46 has its ends connected respectively to the other end of the mounting plate 45 and a bracket 47 secured to a convenient position on the housing of an engine mounted fuel pump 48 (shown diagrammatically in chain-line in Fig. 1) such that the rear edge of arm 23 is urged into abutment with the adjacent face of ear 15 on lever 13. The other end of link rod 42 (not shown) is operatively connected to an accelerator pedal through linkage means (also not shown).

The offset end of arm 23 is operatively connected to one end of a fuel supply lever 49 by a control rod 50 having ball joint 51 at each end thereof. The end of the fuel supply lever 49 remote from the ball joint being secured fast for rotation with the shaft 49a extending transversely from the fuel pump housing and operatively determining the positioning of the fuel rack or metering valve, and hence the fuel supply to the engine.

A solid cylindrical pin 52 is pivotably connected to the end of arm 24 of lever 25 such that the pin extends axially outwardly of the lever and normal to its plane, whilst a hol 53 extending through the pin intermediate its

ends and transversely of the axis thereof receives the flexible inner wir 54 of a bowden cable mechanism such that the inner wire passes freely through the hole extends a predetermined distance beyond the pin and terminates in a nipple 55 of spherical or other suitable shape secured to the end of the inner wire for a purpose to be described later. The inner wire 54 extends generally upwardly from the pin and is received into one end of a flexible outer conduit 56 secured for axial adjustment to a lower wall 57 of bracket 17 by means of a screw-threaded end 58 passing through a hole in the wall 57 and secured thereto by a nut 59 on either side of the wall.

The other end of the outer conduit 56 is secured to housing 60 of a reversible electric motor 61 mounted on a convenient part of the vehicle chassis. Within the housing are means (not shown) for selective axial movement of the inner wire of the bowden cable mechanism in either direction relative to the outer conduit by rotation of the electric motor in the required direction. Such means may comprise for example the inner wire extending within the housing from said other end of the outer conduit and terminating in an axially extending rigid toothed rack portion in mesh with a toothed wheel secured to the end of the motor shaft for rotation therewith when the motor is energised by current from a source of electrical power on the vehicle.

Means to energise the motor 61, which is of the double wound type, may comprise a key-operated multi-positional switch 62 associated with a steering column lock assembly (not shown). One side of the switch is connected to a source of electrical power, i.e. the vehicle battery 63, whilst at least two separate contacts 64, 65 on the other side of the switch are connected to leads 66, 67 respectively each of which is connected to its respective motor-winding and thence to a common earth lead 68. Limit switches 69, 70 are in series with leads 66, 67 respectively, the switches being coupled together by insulated means and actuated by the toothed rack portion of the inner wire of the bowden mechanism reaching the end of its predetermined stroke in one direction or the other such that the limit switch in the energised circuit is opened to de-energise that circuit and stop the motor whilst simultaneously the limit switch in the other motor circuit is closed.

Initial clockwise rotation of the key to the "Aux" position will release the steering column lock and close switch arm 62 against contact 65 to energise the electric motor circuit comprising lead 67 as shown in diagrammtic form in Fig. 5. Contact 65 is elongated to ensure that during further clockwise rotation of the key towards the "Heat" and/or "Start" position, the motor 61 remains energised to obtain the full extent of rack movement in the required direction to fully extend the lower end 54 of the inner wire of the bowden mechanism to a predetermined distance below the pin 52 as shown in Fig. 1. At this point the rack opens limit switch 70 to stop the motor 61 and simulateously closes limit switch 69 in the other circuit of motor 61. In this position as shown in Fig. 1, the control mechanism has been placed in an operable condition with the fuel supply lever in the "idle" position and the engine can be started and operated in a normal manner. The key and hence the switch arm 62 being biassed from the "Heat" and "Start" position to the "Aux" position by spring means.

Anti-clockwise rotation of the key from the "Aux" position to the "off" position will simultaneously lock the steering column and connect switch arm 62 with contact 64. As the limit switch 69 has already been closed by the actions described in the preceding paragraph, the motor 61 will be energised *via* lead 66 in an opposite direction of rotation to move the rack in the opposite direction to retract the lower end of the inner wire into the outer conduit 56 such that nipple 55 is drawn into abutment with pin 52 and thereafter causes simultaneous rotation of levers 21, 25 and 13 a predetermined amount, and in an anti-clockwise direction as viewed in Fig. 1, against springs 16 and 19 to place the fuel supply lever 49 in the "Cut Off" position to stop the engine by rearward movement of rod 50. Withdrawal of the key from the lock will not affect the motor 61 which will remain energised until there has been full movement of the rack causing limit switch 69 to open to stop the motor 61 whilst simultaneously closing limit switch 70. In this condition, the engine cannot be started other than by operation of the key as previously described, as depressing the accelerator pedal will simply cause rotation of shaft 10 together with levers 21 and 32, the fuel supply lever 49 remaining in the "Cut Off" position due to lever 25 being held by the bowden cable mechanism against the action of spring 29.

In a further embodiment as shown in Figs. 3 and 4, the operation of the mechanism is identical to that shown in Figs. 1 and 2 and therefore elements having a like function have been identified by the same reference numbers although the shapes and dispositions of various elements differ somewhat to suit a particular installation condition. For example, shaft 10 is journalled for rotation in a cylindrical housing 71 secured to a vertical mounting plate 72 which is secured to a screw-threaded boss 73 on the engine cylinder block by two set-screws 74. The lower end of the outer conduit 56 is located horizontally and forwardly of pin 52 and is adjustably attached to an abutment ear 75 secured to the mounting plate 72 close to the forward upper corner thereof. The "idle" position of the fuel supply lever 49 is determined by abutment of the

forward edge of the lever against the end of plunger 76 of a spring loaded plunger unit 77 axially adjusted for position on an ar 78 formed integrally with the fuel pump housing 48. Movement of the fuel supply lever 49 to the "Cut-Off" position is permitted by retraction of the plunger 76 into the body of the unit 77 against the action of the spring (not shown) within the unit. A return spring (not shown) is connected to the linkage at a convenient position between an accelerator pedal and lever 32 to bias lever 49 towards the "idle" position.

From the foregoing therefore it can be seen that the engine is stopped automatically when the steering column is locked by withdrawal of the key and cannot be started again whilst the steering column remains locked. It follows therefore that the invention not only contributes to a safer operation of the vehicle, but provides an additional anti-theft device where unauthorised access to the bowden cable mechanism from outside the vehicle engine compartment is made difficult.

Various modifications can be made without departing from the scope of the invention. For example in the embodiment shown in Figs. 1 and 2, shaft 10 may be mounted on a plate secured to the engine instead of the housing 11 formed integrally in the engine block or by *inter alia,* the provision of additional support means, it may be extended such that lever 32 and the linkage to the accelerator pedal is located on the end of the shaft 10 on the opposite side of the engine to the fuel supply lever 49 and associated mechanism. Also, means to actuate the bowden cable mechanism may be other than the rack and toothed wheel arrangement described hereinbefore.

CLAIMS

1. A fuel pump having a control mechanism including a pump control movable from a cut-off position through an idle position to a maximum position, an accelerator mechanism for moving the pump control between the idle and maximum positions and a further mechanism for moving the pump control to and holding the control in the cut-off position irrespective of operation of the accelerator mechanism.

2. A fuel pump as claimed in claim 1, wherein the accelerator mechanism comprises a first part movable with an accelerator for the fuel pump and a second part movable with the pump control, spring means being provided b tween said parts and the arrangement being such that the spring means urges the second part into direct engagement with the first part to follow the first part during movement of the accelerator in a direction to move the pump control towards the maximum position, the further mechanism acting on the second part for moving the second part to and holding th second part in a position corresponding to the cut-off position of the pump control, in which position movement of the acc lerator causes relative movement between the two parts against the action the spring means.

3. A fuel pump as claimed in claim 2, wherein the further mechanism comprises an element having a lost-motion connection to the second part and being movable between a running position and a cut-off position, so that in the running position of the element the lost-motion connection permits movement of the second part relative to the element between positions corresonding to the idle and maximum positions of the pump control, and so that in the cut-off position of the element the lost motion is taken up and the second part is held in the position corresonponding to the cut-off position of the pump control.

4. A fuel pump as claimed in clain 3, wherein the element is the inner cable of a bowden cable mechanism and the second part is provided with a boss having a hole passing therethrough, an end portion of the inner cable passing freely through the hole and a nipple being secured to that end of the inner cable, so that in the running position of the inner cable the lost motion is provided by movement of the boss along the end portion of the inner cable, and so that in the cut-off position of the inner cable the nipple abuts the boss and holds the second part in the position corresponding to the cut-off position of the pump control.

5. A fuel pump as claimed in claim 4, further comprising a reversible electric motor connected to the other end of the bowden cable mechanism to drive the inner cable between the running and cut-off positions.

6. A fuel pump as claimed in claim 5, wherein the motor is connected in circuit with a switch and a power source, the circuit being arranged so that for at least one position of the switch the motor drives the inner cable to the running position and so that for at least one other position of the switch the motor drives the inner cable to the cut-off position.

7. A fuel pump as claimed in claim 6, wherein the motor is of the double wound type, the windings each having one end connected to the power source, the other end of one of the windings being connected to the switch for energisation when the switch is in said one position to rotate the motor in one direction to drive the inner cable to the running position and the other end of the other winding being conn cted to the switch for energisation when the switch is in said other position to rotate the motor in the opposite direction to drive the inner cable to the cut-off position.

8. A fuel pump as claimed in claim 7, wherein said one winding is connected in seri s with a limit switch responsive to position of the inner cable to de-energise that

winding when the inner cable is in the running position and wherein said other winding is connected in series with a further limit switch responsive to position of the inner cable to de-energise that winding when the inner cable is in the cut-off position.

9. A fuel pump as claimed in any one of claims 2 to 8, wherein the first part comprises a shaft having a first crank fixed thereto and linked to the accelerator and having a second crank fixed thereto, and wherein the second part comprises a further crank mounted on the shaft for pivotal movement about the axis thereof and linked to the pump control the spring means acting between the first crank and the further crank and the arrangement being such that the spring means urges the further crank into direct engagement with the second crank to follow the second crank during movement of the accelerator in the direction to move the pump towards the maximum position.

10. A fuel pump as claimed in any preceding claim, further comprising an adjustable stop for setting the idle position of the pump control, the stop being spring loaded to permit movement of the pump control to the cut-off position.

11. A motor vehicle having a fuel pump as claimed in any preceding claim, wherein the further mechanism is operable by a driver of the vehicle from the driving position.

12. A motor vehicle having a mechanism as claimed in claim 6 or any one of claims 7 to 10, as dependent on claim 6 wherein the switch is controlled by a key operated mechanism which also controls a steering lock and a starter motor of the vehicle.

13. A fuel pump substantially as hereinbefore described with reference to and as illustrated in Figs. 1, 2 and 5 or Figs. 3, 4 and 5 of the accompanying drawings.

14. A motor vehicle substantially as hereinbefore described with reference to and as illustrated in Figs. 1, 2 and 5 or Figs. 3, 4 and 5 of the accompanying drawings.

CLAIMS (12 Mar 1980)

1. A fuel pump having a control mechanism including a pump control movable from a cut-off position through an idle position to a maximum position, an accelerator mechanism comprising a first part movable with an accelerator for the fuel pump, a second part movable with the pump control and spring means to urge the second part to follow the first part during movement of the accelerator in a direction to move the pump control from the idle position to the maximum position, and a further mechanism for moving the pump control to and holding the pump control in the cut-off position irrespective of operation of the accelerator mechanism, the further mechanism comprising a bowden cable mechanism having a lost-motion connection to the second part and being movable between a running position and a cut-off position, the lost-motion connection being provided by an end portion of the inner cable of the bowden cable mechanism passing freely through a hole in the second part and an abutment at that end of the inner cable, so that in the running position of the inner cable the lost motion is provided by movement of the second part along the end portion of the inner cable, and so that in the cut-off position of the inner cable the abutment abuts the second part and holds the second part in a position corresponding to the cut-off position of the pump control and movement of the accelerator causes relative movement between the two parts against the action of the spring means.

2. A fuel pump as claimed in claim 1, wherein the second part is provided with a boss in which said hole is formed.

3. A fuel pump as claimed in claim 1 or claim 2, wherein the abutment at said end of the inner cable is provided by a nipple which is secured to that end of the inner cable.

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